Claims:

1. A composition of matter comprising:

   (a) a Group-8, -9, or -10 transition metal, M, excluding palladium;

   (b) an ancillary ligand comprising:

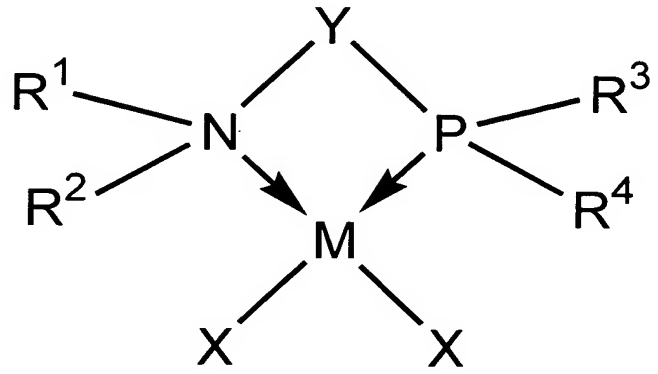
      (i) a terminal amine comprising two independently selected hydrocarbyl radicals, R^1 and R^2;

      (ii) a terminal phosphine comprising two independently selected hydrocarbyl radicals, R^3 and R^4; and

      (iii) a hydrocarbyl bridge, Y, comprising a backbone wherein the hydrocarbyl bridge connects between the terminal amine and the terminal phosphine and wherein the backbone comprises a chain that is four or more carbon atoms long; and

   (c) an abstractable ligand, X.

2. The composition of matter of Claim 1 with the following formula:



wherein

(a) M is a Group-8, -9, or -10 transition metal, excluding palladium,

(b) N is nitrogen;

(c) P is phosphorus;

(d) R^1, R^2, R^3, and R^4 are independently hydrocarbyl radicals;

(e) Y is a hydrocarbyl bridge comprising a backbone wherein the backbone comprises a chain that is four or more carbon atoms long;

(f) X is independently an abstractable ligand.

3. The composition of matter of Claim 2 wherein R^1, R^2, R^3, and R^4 are independently selected from C_1-C_{40} hydrocarbyls.

4. The composition of matter of Claim 3 wherein R^1, R^2, R^3, and R^4 are independently selected from C_1-C_{30} hydrocarbyls.

5. The composition of matter of Claim 4 wherein R^1, R^2, R^3, and R^4 are independently selected from methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, ethenyl, propenyl, butenyl, pentenyl, hexenyl, heptenyl, octenyl, nonenyl, decenyl, undecenyl, dodecenyl, ethynyl, propynyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, decynyl, undecynyl, dodecynyl, phenyl, benzyl, phenethyl, tolyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, cyclododecyl radicals.

6. The composition of matter of Claim 5 wherein R^1, R^2, R^3, and R^4 are independently selected from from methyl, ethyl, propyl, butyl, cyclohexyl, phenyl, tolyl, benzyl, and phenethyl.

7. The composition of matter of Claim 2 wherein X are independently hydride radicals; hydrocarbyl radicals; hydrocarbyl-substituted, organometalloid radicals; or two X's are connected to form a 3-to-50-atom metallacycle ring.

8. The composition of matter of Claim 2 wherein X are independently halogen, alkoxide, aryloxide, amide, or phosphide radicals.

9. The composition of matter of Claim 8 wherein X are independently chloride, bromide, iodide, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diethylamino, methylethylamino, phenoxy, benzoxy,

10. The composition of matter of Claim 7 wherein X are independently halogen, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, hydride, phenyl, benzyl, phenethyl, tolyl,

11. The composition of matter of Claim 2 wherein X are independently allyl, 1,1-dimethyl allyl, 2-carboxymethyl allyl, acetylacetonate, 1,1,1,5,5,5-hexa-fluoroacetylacetonate, 1,1,1-trifluoro-acetylacetonate, or 1,1,1-trifluoro-5,5-di-methylacetylacetonate radicals.

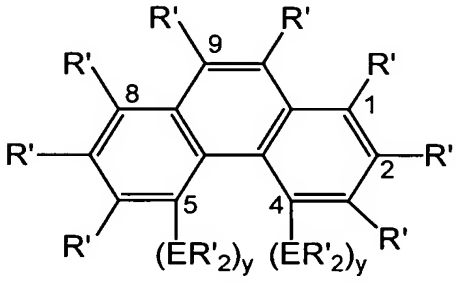
12. The composition of matter of Claim 2 wherein M is selected from nickel, iron, cobalt, platinum, ruthenium, osmium, rhodium, and iridium.

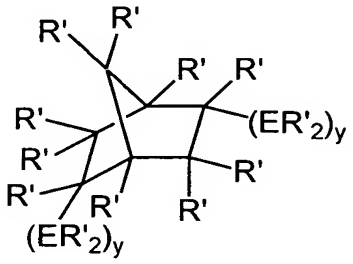
13. The composition of matter of Claim 12 wherein M is selected from iron, nickel, and cobalt.

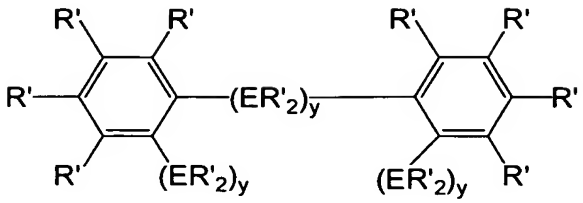
14. The composition of matter of Claim 12 wherein Y is selected from butylene, pentylene, hexylene, heptylene, octylene, nonylene, decylene, undecylene, dodecylene, tridecylene, tetradecylene, pentadecylene, hexadecylene, heptadecylene, octadecylene, nonadecylene, eicosylene, heneicosylene, docosylene, tricosylene, tetracosylene, pentacosylene, hexacosylene, heptacosylene, octacosylene, nonacosylene, triacontylene, cyclohexylene, cyclooctylene, cyclodecylene, cyclododecylene, biphenyl, butenylene, penentylene, hexenylene, heptenylene, octenylene, nonenylene, decenylene, undecenylene, dodecenylene, hexynylene, heptynylene, octynylene, nonynylene, decynylene, undecynylene, dodecynylene, butadienylene, pentadienylene, hexadienylene, heptadienylene, octadienylene, nonadienylene, decadienylene, undecadienylene, dodecadienylene, hexatrienylene, octatrienylene, decatrienylene, and dodecatrienylene radicals.

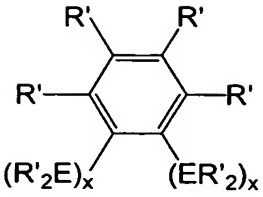
15. The composition of matter of 14 wherein Y is selected from biphenyl.

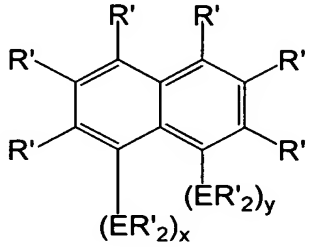
16. The composition of matter of 14 wherein Y has one of the following formulas:

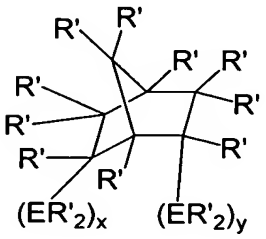


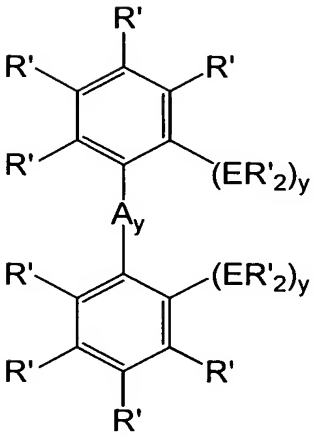


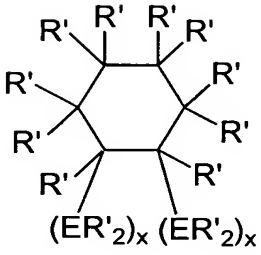


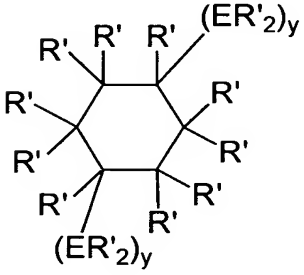


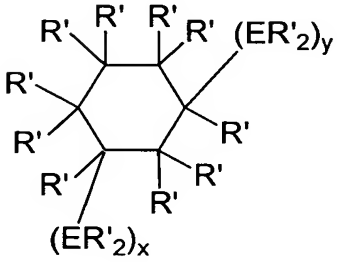


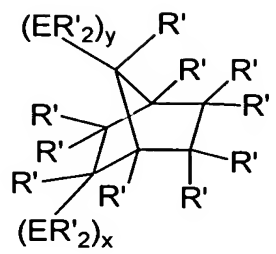


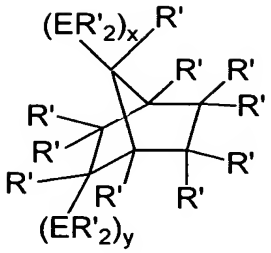


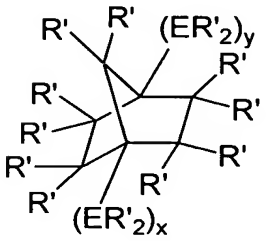


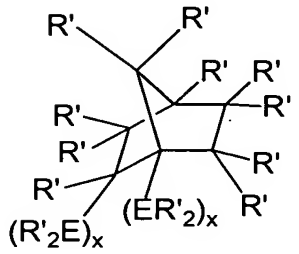


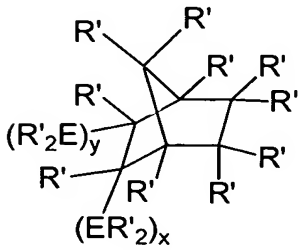


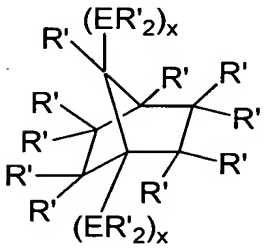


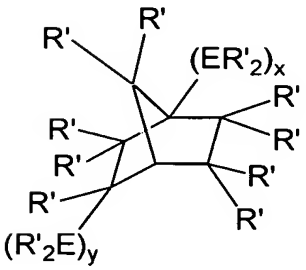


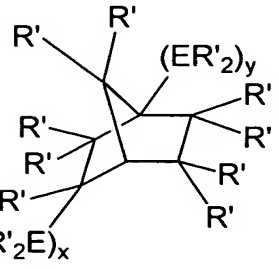












where

(a) R' are independently, hydrogen or C_1-C_{50} hydrocarbyl radicals;

(b) A is a non-hydrocarbon atom functional group;

(c) E is a Group-14 element;

(d) x is an integer from 1 to 4; and

(e) y is an integer from 0 to 4.

17. The composition of Claim 16 wherein A is selected from C=O, C=S, O, S, SO_2, NR*, PR*, BR*, SiR^*_2, and GeR^*_2 wherein R* is independently a hydrocarbyl or halocarbyl radical.

18. A composition of matter comprising the reaction product of an activator and the composition of matter of Claim 2.

19. A composition of matter comprising the reaction product of

(a) the composition of matter of Claim 18 and

(b) ethylene, propylene, 1-butene, or a mixture of any two or all three of ethylene, propylene, and 1-butene.

20. A polymerization method comprising the step of providing at least one composition of matter of Claim 2.

21. The polymerization method of Claim 16 wherein the catalysts activity exceeds 8000 moles of ethylene per mole transition metal per hour

22. The polymerization method of any of Claim 20 further comprising recovering a product comprising greater than 50 wt% of linear C_4-C_{14} α-olefins based on the total weight of polymerized product.

23. The polymerization method of Claim 22 wherein the product comprises greater than 80 wt% of linear C_4-C_{14} α-olefins.

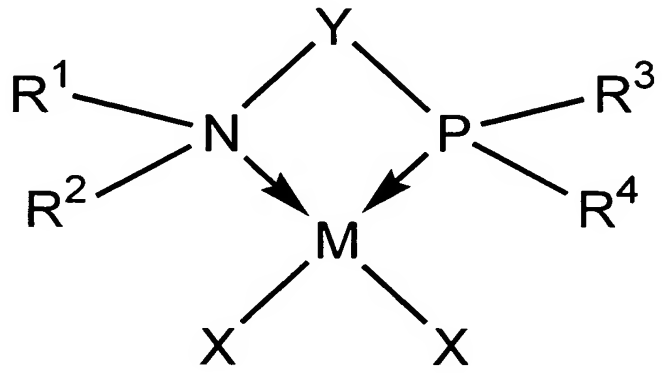
24. The polymerization method of Claim 23 wherein the product comprises greater than 50 wt% of linear C_4 and C_6 α-olefins.

25. The polymerization method of Claim 24 wherein the product comprises greater than 80 mol% of linear C_4 and C_6 α-olefins.

26. A composition of matter comprising the reaction product of:

(a) an activator; and

(b) a catalyst precursor with the following formula:



wherein

(i) M is iron, nickel, cobalt, and palladium;

(ii) N is nitrogen;

(iii) P is phosphorus;

(iv) R^1, R^2, R^3, and R^4 are independently selected from methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, ethenyl, propenyl, butenyl, pentenyl,

hexenyl, heptenyl, octenyl, nonenyl, decenyl, undecenyl, dodecenyl, ethynyl, propynyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, decynyl, undecynyl, dodecynyl, phenyl, benzyl, phenethyl, tolyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, cyclododecyl radicals;

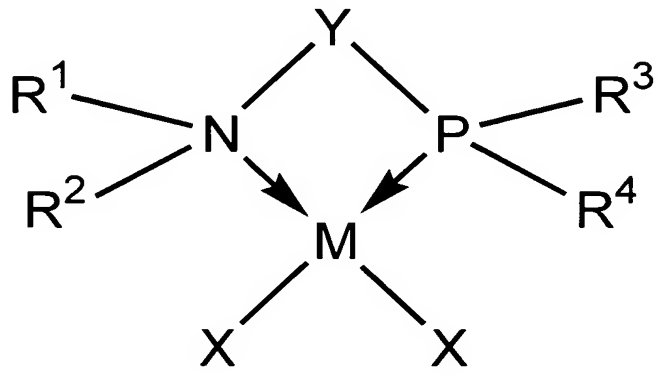
(v) Y is a hydrocarbyl bridge comprising a backbone wherein the backbone comprises a chain that is four or more carbon atoms long;

(vi) X are independently abstractable ligands.

27. A composition of matter comprising the reaction product of:

(a) an activator; and

(b) a catalyst precursor with the following formula:



wherein

(i) M is from nickel, iron, cobalt, palladium, platinum, ruthenium, osmium, rhodium, and iridium;

(ii) N is nitrogen;

(iii) P is phosphorus;

(iv) R^1, R^2, R^3, and R^4 are independently selected from methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, ethenyl, propenyl, butenyl, pentenyl, hexenyl, heptenyl, octenyl, nonenyl, decenyl, undecenyl, dodecenyl, ethynyl, propynyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, decynyl, undecynyl, dodecynyl, phenyl, benzyl, phenethyl, tolyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, cyclododecyl radicals;

(v) Y is a hydrocarbyl bridge comprising a backbone wherein the backbone comprises a chain that is four or more carbon atoms long; and

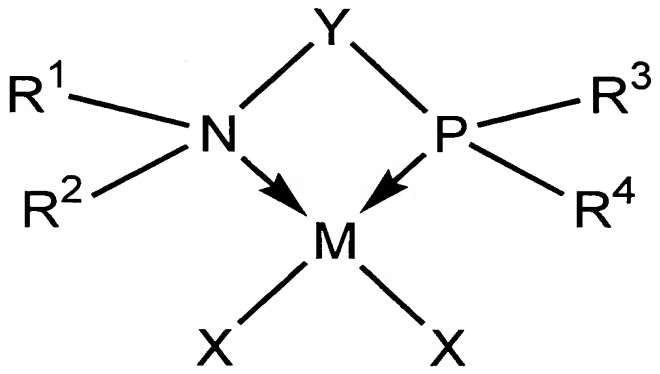
(vi) X are independently chloride, bromide, iodide, methoxide, ethoxide, dimethylamide, diethylethoxide, phenoxide, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, hydride, phenyl, benzyl, phenethyl, tolyl, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diethylamino, methylethylamino, acetylacetonate, 1,1,1,5,5,5-hexa-fluoroacetylacetonate, 1,1,1-trifluoro-acetylacetonate, or 1,1,1-trifluoro-5,5-di-

methylacetylacetonate radicals; or two X's are connected to form a 3-to-40-atom metallacycle ring.

28. A composition of matter comprising the reaction product of:

(a) an activator; and

(b) a catalyst precursor with the following formula:



wherein

(i) M is from nickel, iron, cobalt, palladium, platinum, ruthenium, osmium, rhodium, and iridium;

(ii) N is nitrogen;

(iii) P is phosphorus;

(iv) R^1, R^2, R^3, and R^4 are independently selected from methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, ethenyl, propenyl, butenyl, pentenyl, hexenyl, heptenyl, octenyl, nonenyl, decenyl, undecenyl,

dodecenyl, ethynyl, propynyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, decynyl, undecynyl, dodecynyl, phenyl, benzyl, phenethyl, tolyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, cyclododecyl radicals;

(v) Y is is selected from butylene, pentylene, hexylene, heptylene, octylene, nonylene, decylene, undecylene, dodecylene, tridecylene, tetradecylene, pentadecylene, hexadecylene, heptadecylene, octadecylene, nonadecylene, eicosylene, heneicosylene, docosylene, tricosylene, tetracosylene, pentacosylene, hexacosylene, heptacosylene, octacosylene, nonacosylene, triacontylene, cyclohexylene, cyclooctylene, cyclodecylene, cyclododecylene, biphenyl, butenylene, penentylene, hexenylene, heptenylene, octenylene, nonenylene, decenylene, undecenylene, dodecenylene, hexynylene, heptynylene, octynylene, nonynylene, decynylene, undecynylene, dodecynylene, butadienylene, pentadienylene, hexadienylene, heptadienylene, octadienylene, nonadienylene, decadienylene, undecadienylene, dodecadienylene, hexatrienylene, octatrienylene, decatrienylene, and dodecatrienylene radicals; and

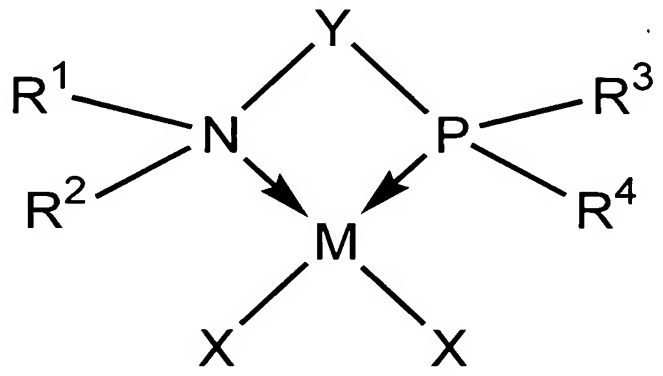
(vi) X are independently chloride, bromide, iodide, methoxide, ethoxide, dimethylamide, diethylethoxide, phenoxide, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, hydride, phenyl, benzyl, phenethyl, tolyl,

methoxy, ethoxy, propoxy, butoxy, dimethylamino, diethylamino, methylethylamino, acetylacetonate, 1,1,1,5,5,5-hexa-fluoroacetylacetonate, 1,1,1-trifluoro-acetylacetonate, or 1,1,1-trifluoro-5,5-di-methylacetylacetonate radicals; or two X's are connected to form a 3-to-40-atom metallacycle ring.

29. A composition of matter comprising the reaction product of:

(a) an activator; and

(b) a catalyst precursor with the following formula:



wherein

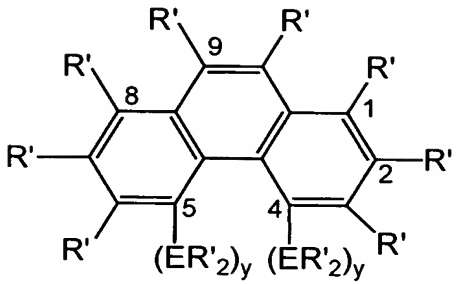
(i) M is a Group-8, -9, or -10 transition metal;

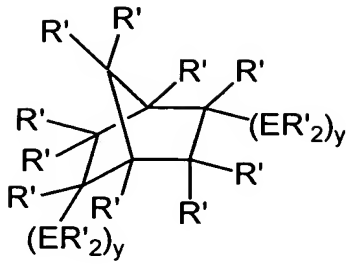
(ii) N is nitrogen;

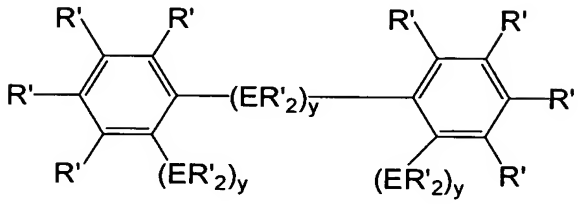
(iii) P is phosphorus;

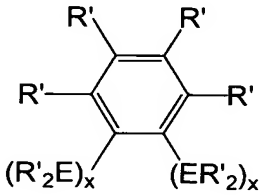
(iv) R^1, R^2, R^3, and R^4 R^1, R^2, R^3, and R^4 are independently hydrocarbyl radicals;

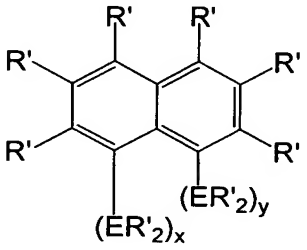
(v) Y is represented by one of the following formulas:

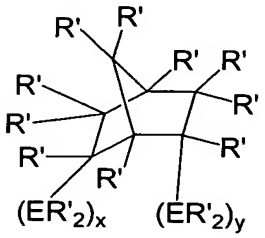

R'
9
8
1
2
5
4
(ER'2)y

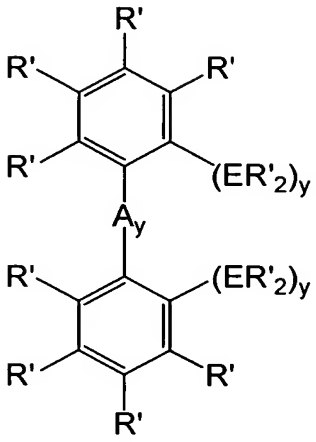

R'
(ER'2)y

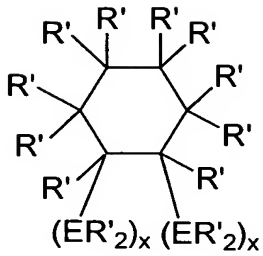

R'
(ER'2)y

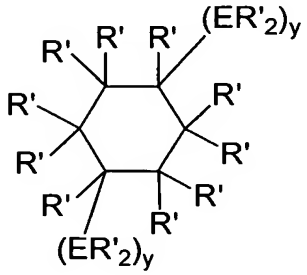

R'
(R'2E)x
(ER'2)x

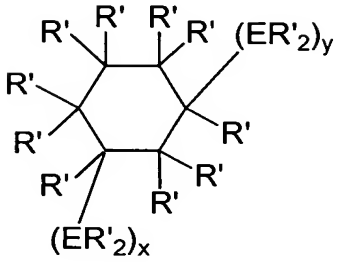

R'
(ER'2)y
(ER'2)x

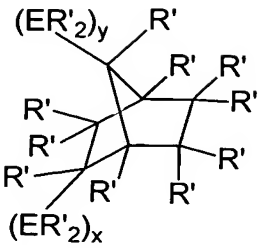

R'
(ER'2)x
(ER'2)y

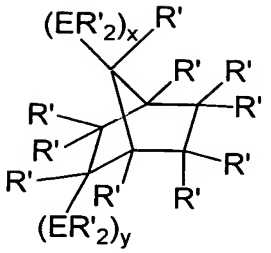


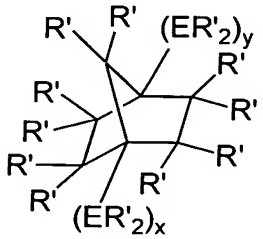


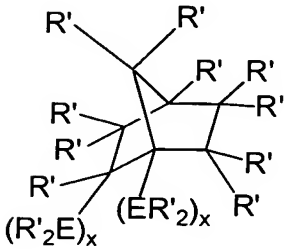


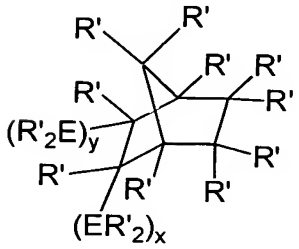


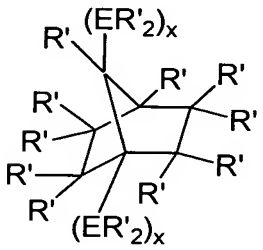


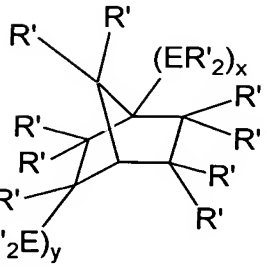


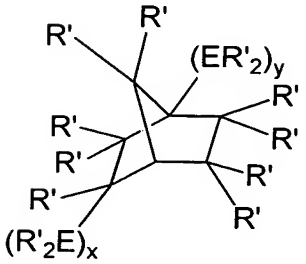












where

- R' are independently, hydrogen or C_1-C_{50} hydrocarbyl radicals;

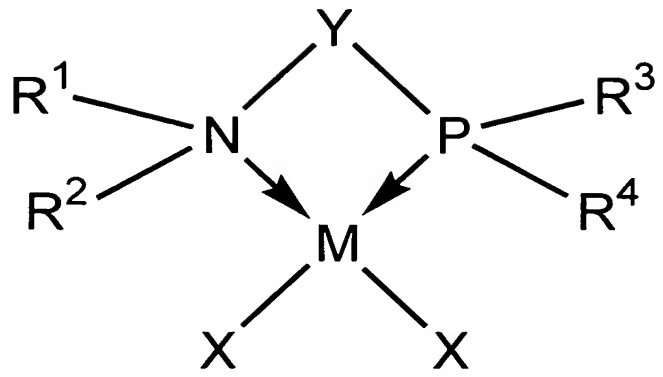
- A is a non-hydrocarbon atom functional group;
- E is a Group-14 element;
- x is an integer from 1 to 4; and
- y is an integer from 0 to 4.

(vi) X are independently chloride, bromide, iodide, methoxide, ethoxide, dimethylamide, diethylethoxide, phenoxide, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, hydride, phenyl, benzyl, phenethyl, tolyl, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diethylamino, methylethylamino, acetylacetonate, 1,1,1,5,5,5-hexa-fluoroacetylacetonate, 1,1,1-trifluoro-acetylacetonate, or 1,1,1-trifluoro-5,5-di-methylacetylacetonate radicals; or two X's are connected to form a 3-to-40-atom metallacycle ring.

30. A polymerization method wherein the catalysts activity exceeds 8000 moles of ethylene per mole transition metal per hour comprising the step of providing at least one composition of matter comprising the reaction product of:

(a) an activator; and

(b) a catalyst precursor with the following formula:



wherein

(i) M is iron, nickel, cobalt, and palladium;

(ii) N is nitrogen;

(iii) P is phosphorus;

(iv) R^1, R^2, R^3, and R^4 are independently selected from methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, ethenyl, propenyl, butenyl, pentenyl, hexenyl, heptenyl, octenyl, nonenyl, decenyl, undecenyl, dodecenyl, ethynyl, propynyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, decynyl, undecynyl, dodecynyl, phenyl, benzyl, phenethyl, tolyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, cyclododecyl radicals;

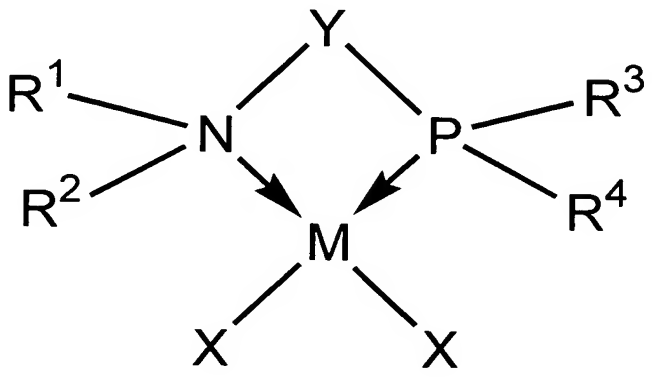
(v) Y is a hydrocarbyl bridge comprising a backbone wherein the backbone comprises a chain that is four or more carbon atoms long;

(vi) X are independently abstractable ligands.

31. A polymerization method wherein the catalysts activity exceeds 8000 moles of ethylene per mole transition metal per hour comprising the step of providing at least one composition of matter comprising the reaction product of:

(a) an activator; and

(b) a catalyst precursor with the following formula:



wherein

(i) M is from nickel, iron, cobalt, palladium, platinum, ruthenium, osmium, rhodium, and iridium;

(ii) N is nitrogen;

(iii) P is phosphorus;

(iv) R^1, R^2, R^3, and R^4 are independently selected from methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, ethenyl, propenyl, butenyl, pentenyl,

hexenyl, heptenyl, octenyl, nonenyl, decenyl, undecenyl, dodecenyl, ethynyl, propynyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, decynyl, undecynyl, dodecynyl, phenyl, benzyl, phenethyl, tolyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, cyclododecyl radicals;

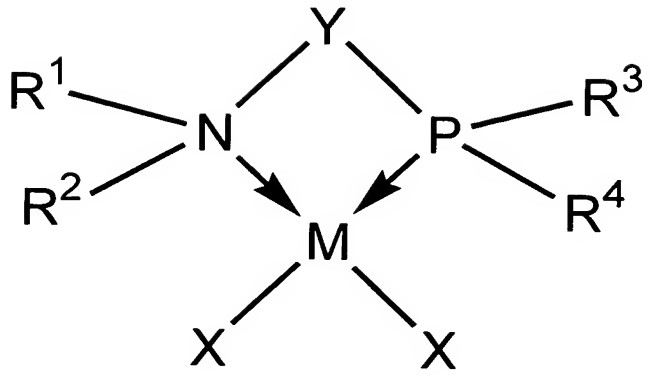
(v) Y is a hydrocarbyl bridge comprising a backbone wherein the backbone comprises a chain that is four or more carbon atoms long; and

(vi) X are independently chloride, bromide, iodide, methoxide, ethoxide, dimethylamide, diethylethoxide, phenoxide, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, hydride, phenyl, benzyl, phenethyl, tolyl, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diethylamino, methylethylamino, acetylacetonate, 1,1,1,5,5,5-hexa-fluoroacetylacetonate, 1,1,1-trifluoro-acetylacetonate, or 1,1,1-trifluoro-5,5-di-methylacetylacetonate radicals; or two X's are connected to form a 3-to-40-atom metallacycle ring.

32. A polymerization method wherein the catalysts activity exceeds 8000 moles of ethylene per mole transition metal per hour comprising the step of providing at least one composition of matter comprising the reaction product of:

(a) an activator; and

(b) a catalyst precursor with the following formula:



wherein

(i) M is from nickel, iron, cobalt, palladium, platinum, ruthenium, osmium, rhodium, and iridium;

(ii) N is nitrogen;

(iii) P is phosphorus;

(iv) R^1, R^2, R^3, and R^4 are independently selected from methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, ethenyl, propenyl, butenyl, pentenyl, hexenyl, heptenyl, octenyl, nonenyl, decenyl, undecenyl, dodecenyl, ethynyl, propynyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, decynyl, undecynyl, dodecynyl, phenyl, benzyl, phenethyl, tolyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, cyclododecyl radicals;

(v) Y is is selected from butylene, pentylene, hexylene, heptylene, octylene, nonylene, decylene, undecylene, dodecylene, tridecylene, tetradecylene, pentadecylene,

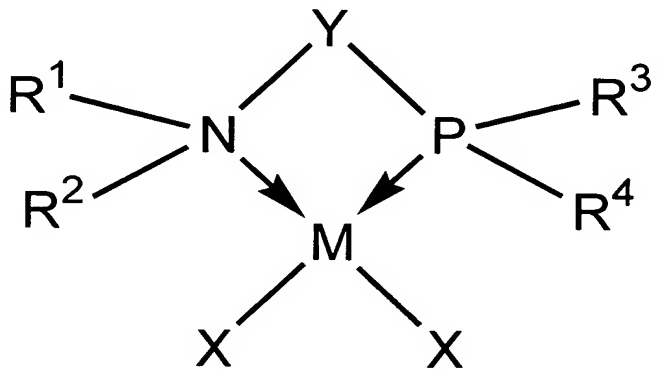
hexadecylene, heptadecylene, octadecylene, nonadecylene, eicosylene, heneicosylene, docosylene, tricosylene, tetracosylene, pentacosylene, hexacosylene, heptacosylene, octacosylene, nonacosylene, triacontylene, cyclohexylene, cyclooctylene, cyclodecylene, cyclododecylene, biphenyl, butenylene, penentylene, hexenylene, heptenylene, octenylene, nonenylene, decenylene, undecenylene, dodecenylene, hexynylene, heptynylene, octynylene, nonynylene, decynylene, undecynylene, dodecynylene, butadienylene, pentadienylene, hexadienylene, heptadienylene, octadienylene, nonadienylene, decadienylene, undecadienylene, dodecadienylene, hexatrienylene, octatrienylene, decatrienylene, and dodecatrienylene radicals; and

(vi) X are independently chloride, bromide, iodide, methoxide, ethoxide, dimethylamide, diethylethoxide, phenoxide, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, hydride, phenyl, benzyl, phenethyl, tolyl, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diethylamino, methylethylamino, acetylacetonate, 1,1,1,5,5,5-hexa-fluoroacetylacetonate, 1,1,1-trifluoro-acetylacetonate, or 1,1,1-trifluoro-5,5-di-methylacetylacetonate radicals; or two X's are connected to form a 3-to-40-atom metallacycle ring.

33. A polymerization method wherein the catalysts activity exceeds 8000 moles of ethylene per mole transition metal per hour comprising the step of providing at least one composition of matter comprising the reaction product of:

(a) an activator; and

(b) a catalyst precursor with the following formula:



wherein

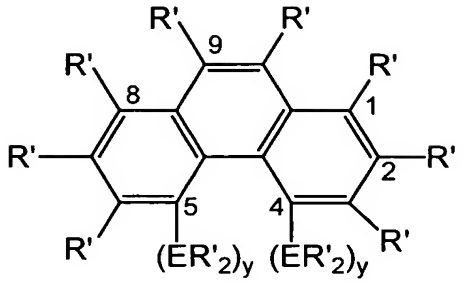
(i) M is a Group-8, -9, or -10 transition metal;

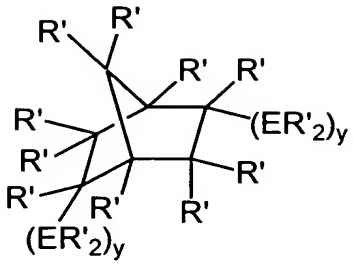
(ii) N is nitrogen;

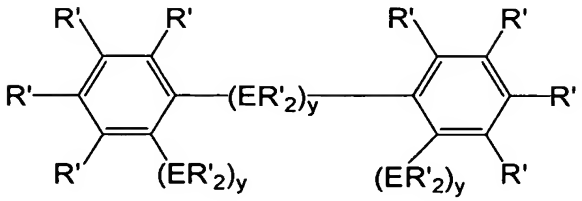
(iii) P is phosphorus;

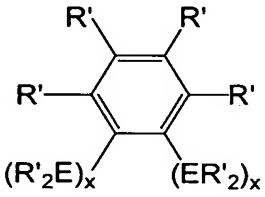
(iv) R^1, R^2, R^3, and R^4 R^1, R^2, R^3, and R^4 are independently hydrocarbyl radicals;

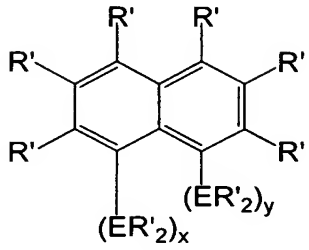
(v) Y is represented by one of the following formulas:

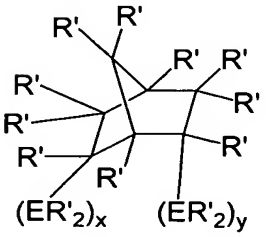

R'
9
R'
R'
8
1
R'
2
R'
5
4
R'
R'
(ER'2)y
(ER'2)y
R'

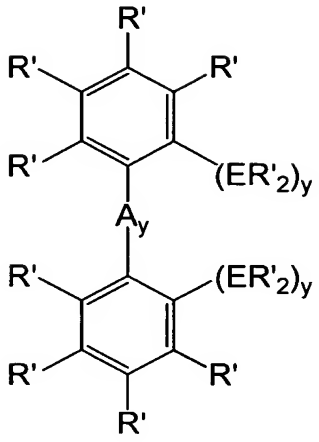

R'
R'
R'
R'
(ER'2)y
R'
R'
R'
R'
R'
(ER'2)y

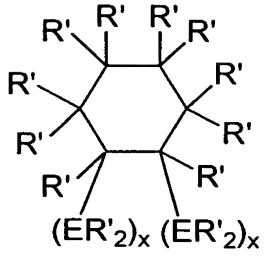

R'
R'
R'
R'
R'
(ER'2)y
R'
R'
(ER'2)y
(ER'2)y
R'

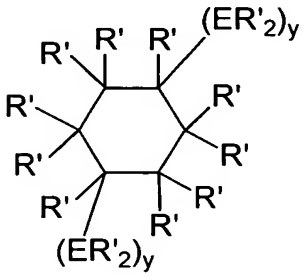

R'
R'
R'
R'
(R'2E)x
(ER'2)x

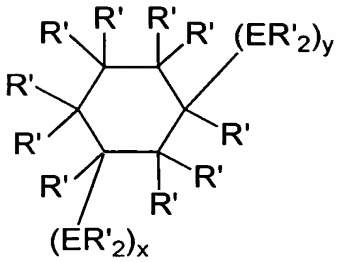

R'
R'
R'
R'
R'
R'
(ER'2)y
(ER'2)x

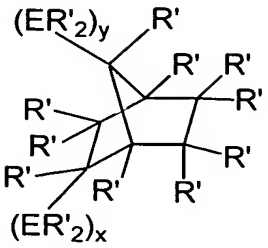

R'
R'
R'
R'
R'
R'
R'
R'
R'
(ER'2)x
(ER'2)y

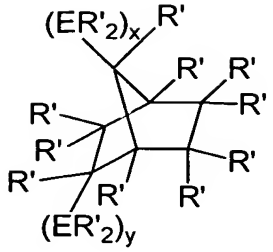


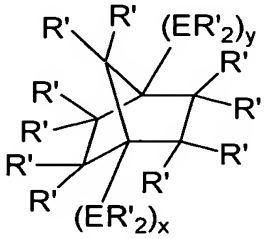


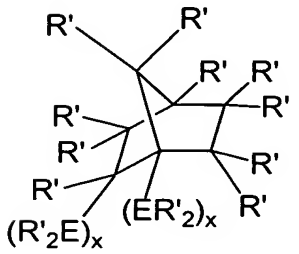


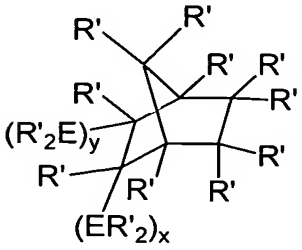


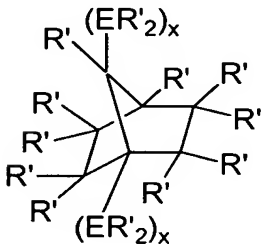


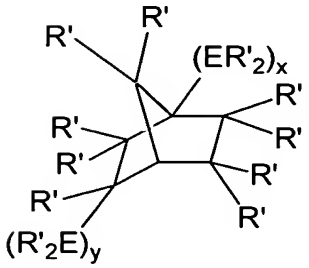


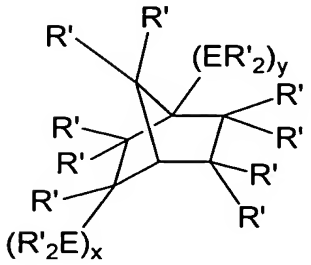












where

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- A is a non-hydrocarbon atom functional group;
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